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Disturbance of eelgrass (Zostera marina L.) by commercial mussel (Mytilus edulis) harvesting in Maine: Dragging impacts and habitat recovery

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We studied the effects of commercial harvest of blue mussels (Mytilus edulis) on eelgrass (Zostera marina L.) in Maquoit Bay, Maine, USA. We used aerial photography, underwater video, and eelgrass population- and shoot-based measurements to quantify dragging impacts within 4 sites that had been disturbed at different times over an approximate 7-year interval, and to project eelgrass meadow recovery rates. Dragging had disturbed 10 % of the eelgrass cover in Maquoit Bay, with dragged sites ranging from 3.4 to 31.8 ha in size. Dragging removed above- and belowground plant material from the majority of the bottom in the disturbed sites. One year following dragging, eelgrass shoot density, shoot height, and total biomass of disturbed sites averaged respectively 2-3%, 46 – 61 %, and <1 % that of the reference sites. Substantial differences in eelgrass biomass persisted between disturbed and reference sites up to 7 years after dragging. Dragging did not affect physical characteristics of the sediment. The pattern and rate of eelgrass bed recovery depended on initial dragging intensity; areas of relatively light dragging with many remnant eelgrass patches (i.e. patches that were missed by the mussel dredge) showed considerable revegetation in 1 year. However, by developing recovery trajectories from measurements at sites disturbed in different years, we projected that it would require a mean of 10.6 years for recovery of eelgrass shoot density and 16.3 years for full recovery of eelgrass biomass within the areas of intense dragging characterizing most of the disturbed sites. A spatial simulation model based on measured rates of lateral patch-expansion (mean 12.5 cm yr-1) and new-patch recruitment (mean 0.19 patches m-2 yr-1) yielded a mean bed recovery time of 9 – 11 yr following dragging, depending on initial degree of plant removal. Model simulations suggested that with favorable environmental conditions, eelgrass beds might recover from dragging disturbance in 6 yr; conversely, recovery under conditions less conducive to eelgrass growth could require 20 yr or longer. This study shows that mussel dragging poses a severe threat to eelgrass in this region, and that regulations to protect eelgrass from dragging impacts would maintain the integrity of a substantial amount of habitat.